Nuclear Data Measurements in Russia

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- Measurements of the (n, α) cross sections;
- Measurements of the delayed neutron yields;
- Measurements of the residue yields for high energy protons

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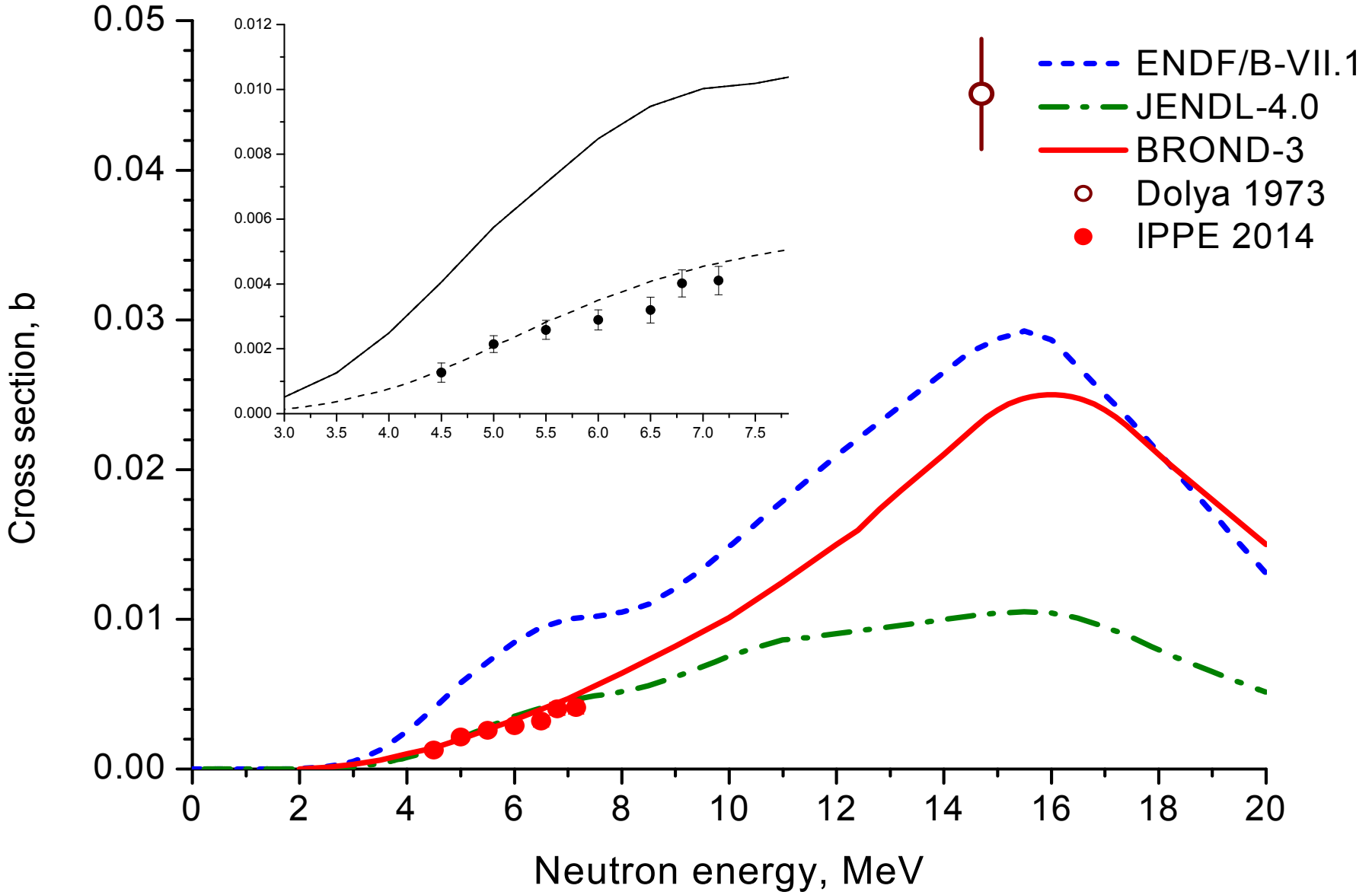
The cross sections of (n,α) reactions

In last years essential improvements were achieved in measurements of the (n,α) and (n,p) reactions on light nuclei by means of the ionization chambers, the working gas of which serves simultaneously the target material. The methods of a digital spectrometry are widely used in such measurements for identification of reaction product parameters inside a gas-volume, and the corresponding high-precision equipment was developed successfully in a collaboration of IPPE (Obninsk) and IRMM (Geel). Such ionization chambers were manufactured at IRMM and IPPE and used for precise measurements of the (n,α) cross sections for some important light nuclides.

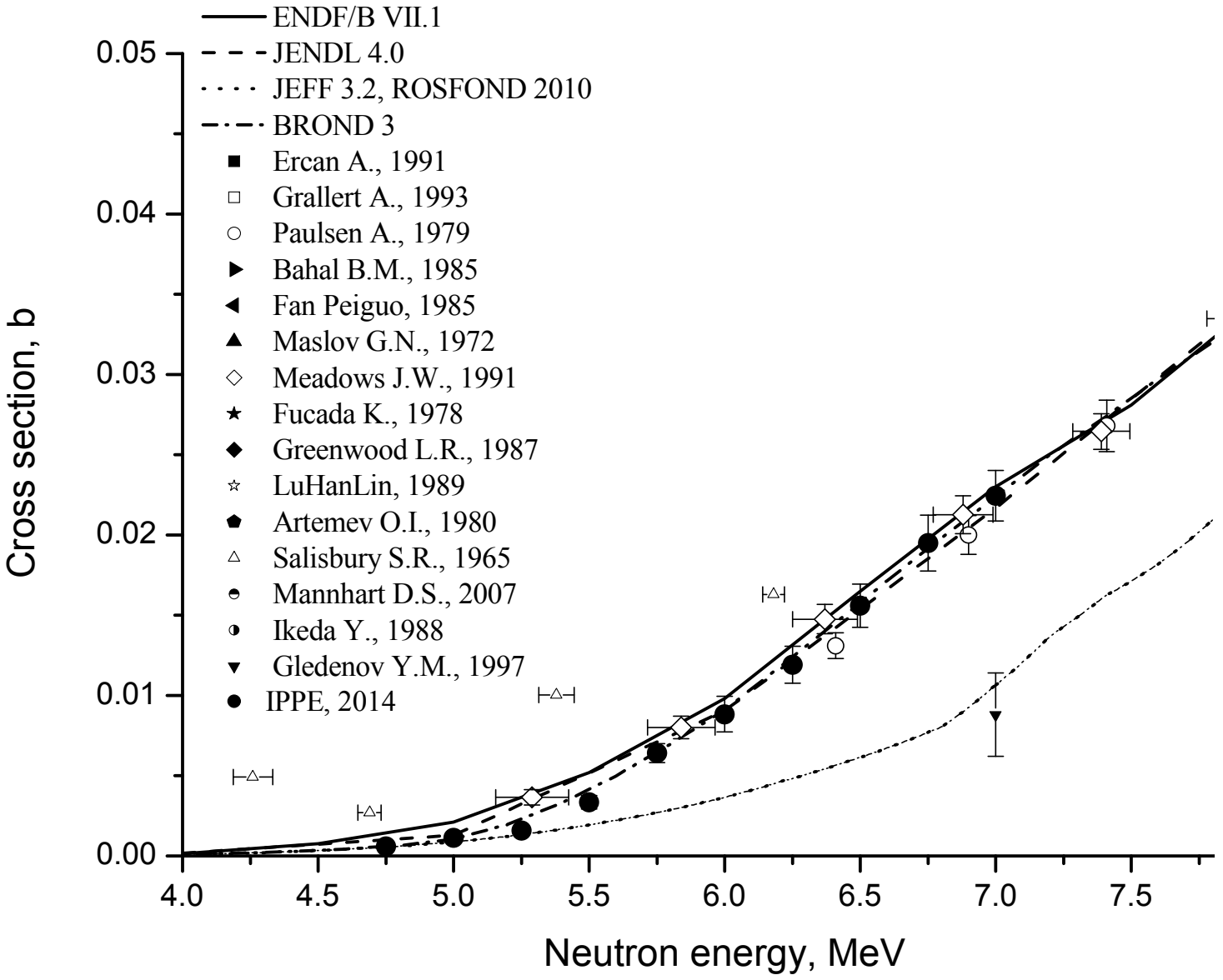
Now the corresponding spectrometer was used for the metallic targets. During 2014 the cross sections of the ^{50}Cr(n,α) and ^{54}Fe(n,α) reactions have been measured for the neutron energies below 7 MeV. The obtained data are shown in the following slides together with the recent evaluations and other experimental data. Cross sections of the ^{57}Fe(n,α), ^{60}Ni(n,α), and ^{64}Zn(n,α) reactions were measured too, but these data are still processing.

I.P. Bondarenko Proc. Workshop ISINN-2014, JINR, Dubna, 2015

New experimental data on the $^{50}Cr(n,\alpha)$ cross sections



New experimental data on the $^{54}Fe(n,\alpha)$ cross sections

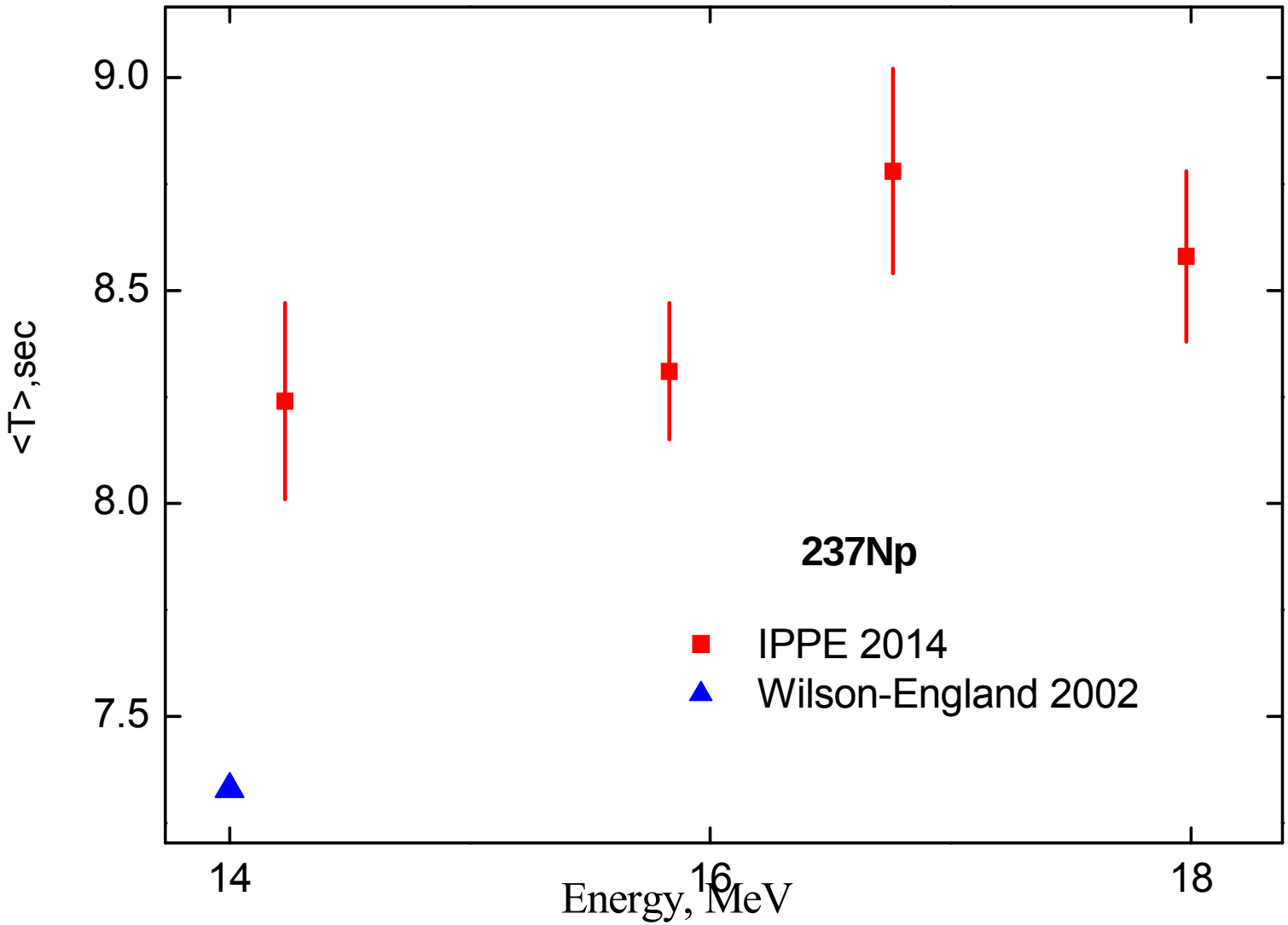


Measurements of the delayed neutron yields

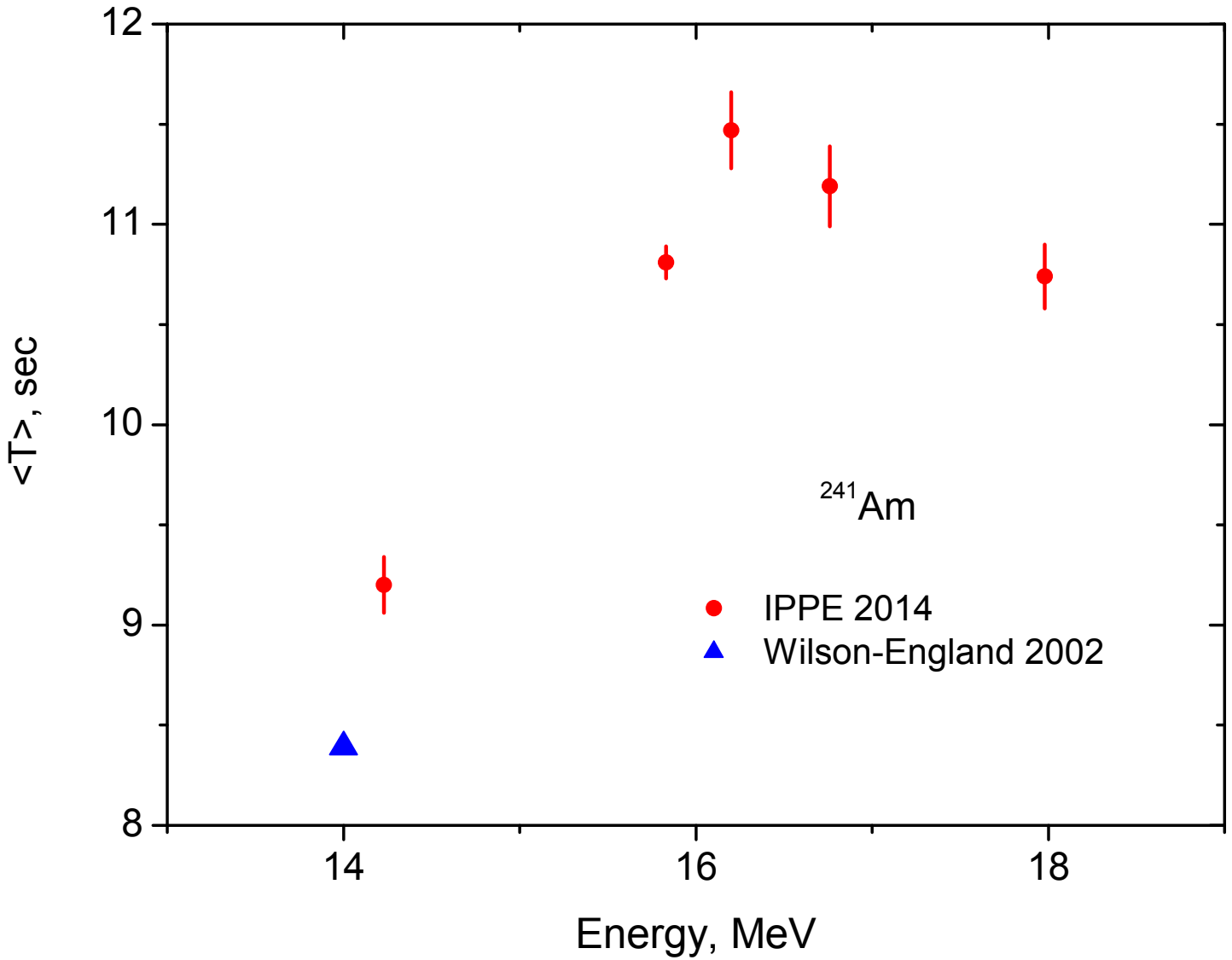
In previous years a great amount of measurements was perfoemed at IPPE for the delayed neutron yields of the most important actinides for the neutron energies below 5 MeV. Now such measurements are continued for the energies above 14 MeV.
The total DN yield and the average DN half-lives were measured in 2014 for ^{237}Np and ^{241}Am for the incident-neutron energies between 14 and 18 MeV. The main results are shown in the following slides.

Gremyachkin D.E., Piksaikin V.M., Mitrofanov K.V., Egorov A.S. Workshop on Neutronics-2014, IPPE, Obninsk, 2014.

New experimental data for ^{237}Np



New experimental data for ^{241}Am



High resolution measurements of delayed neutron spectra in different time intervals for the thermal neutron fission of ^{235}U

Composite delayed energy spectra from epithermal neutron induced fission of ^{235}U have been measured for twelve delay-time intervals extending from 0.12 to 150 s. Measurements with different irradiation and counting time intervals were made to emphasize particular delayed neutron precursors. Two sets of measurements have been performed: with irradiation time of 20 and 120 s, which followed by measurements of spectra for 5 time intervals from 0 to 152 s after irradiation.

These data provide a comprehensive set of composite spectra having enhanced sensitivity to neutrons emitted in less than 1 s following fission. That is the first composite delayed neutron measurements that show good overall agreement with the spectra obtained by summation calculations. Such agreement is very important for a selection of the consistent database for the DN description.

Piksaikin V.M. et al., Report IAEA-NDS, Vienna, 2015

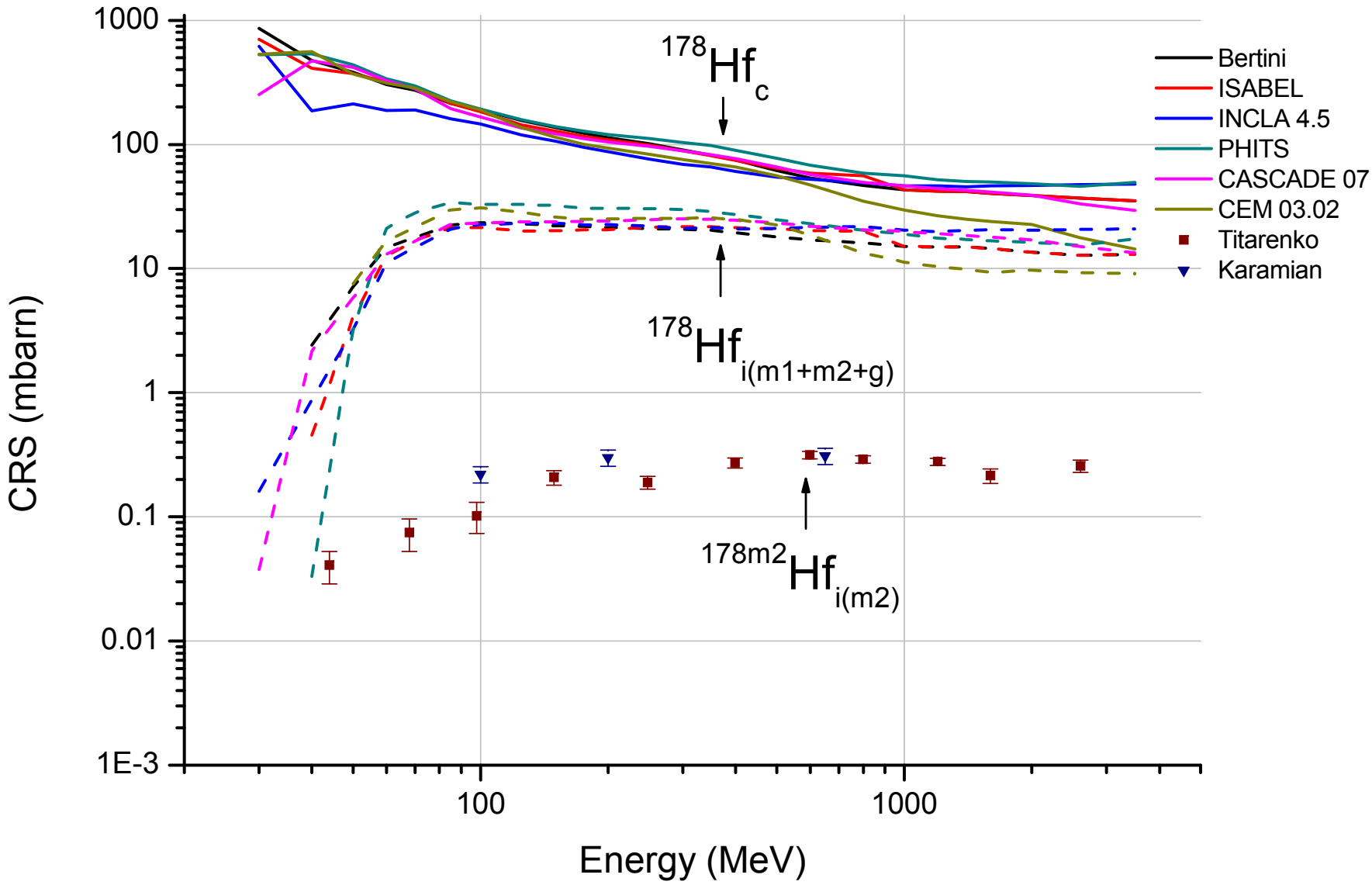
Excitation functions of the ^{nat}Ta(p, x)^{178m2}Hf and ^{nat}W(p, x)^{178m2}Hf reactions at energies up to 2600 MeV

Irradiations of the thin targets of ^{nat}Ta and ^{nat}W with protons in the energy range of 40-2600 MeV have been performed at the ITEP accelerator during the period from September 1, 2006 to August 31, 2009 within the framework of the ISTC Project #3266. These data were presented in the form of 173 residual excitation functions for ^{nat}Ta and 193 excitation functions for ^{nat}W. However, on account of an essential background in the region of gamma-ray lines corresponding to ^{178m2}Hf, the yield of this isomer has not been determined.

To estimate the yields of ^{178m2}Hf the measurements of gamma-spectra for the early irradiated samples of ^{nat}Ta and ^{nat}W were continued during 2012 – 2014. The increased time after irradiation provides a significant decrease in the radioactivity background due to the natural decay of the reaction products with short half-lives, and that allows to identify the ^{178m2}Hf by its distinctive gamma lines quite confidently.

Yu. E. Titarenko et al., Submitted to Phys. Rev. C, 2015

Calculated cross sections for ^{178c}Hf , ^{178i}Hf and experimental data of the excitation function for ^{nat}Ta(p,x)^{178m2}Hf reaction



Estimated isomer ratios for the $^{181}Ta(p,x)^{178m2}Hf$ reaction compared with the TENDL-2012 and the low-energy data for the $^{179}Hf(n,2n)^{178m2}Hf$ reaction